SECTION 05500

METAL FABRICATIONS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes
1. Painted exterior and interior steel guardrails, handrails and railings, bollards.
2. Miscellaneous tubes, channels, angles and other shapes as required.
3. Rough hardware.

B. Products Furnished But Not Installed Under This Section
1. Section 03100 - Concrete Formwork: Placement of metal fabrications to be embedded in concrete.

C. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

D. Related Sections
1. Section 03300 - Cast-In-Place Concrete: Provision of concrete substrate.

1.02 REFERENCES

A. AISC - American Institute of Steel Construction

B. ANSI - American National Standards Institute
1. B18.6.3 - Machine Screws and Machine Screw Nuts (M4)
2. B18.21.1 - Lock Washers (Inch Series)
3. B18.22.1 - Plain Washers.

C. ASTM - American Society for Testing and Materials
1. A27 - Standard Specification for Steel Castings, Carbon, for General Application.
2. A36 - Standard Specification for Structural Steel.
3. A47 - Standard Specification for Ferritic Malleable Iron Castings.
4. A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
5. A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
6. A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
7. A276 - Standard Specification for Stainless Steel Bars and Shapes.
8. A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 Psi Tensile Strength.
9. A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
10. A563 - Standard Specification for Carbon and Alloy Steel Nuts.
11. A780 - Practice for Repair of Damaged Hot-Dip Galvanized Coatings.
12. B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
13. B633 - Standard Specification for Electro-Deposited Coatings of Zinc on Iron and Steel.

14. C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-Shrink).
15. E488 - Test Method for Strength of Anchors in Concrete and Masonry Elements.
16. F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws and Studs.
17. F594 - Standard Specification for Stainless Steel Nuts.

D. AWS - American Welding Society
1. D1.1 - Structural Welding Code - Steel.
2. D1.3 - Structural Welding Code - Sheet Steel.
3. D1.4 - Structural Welding Code - Reinforcing for Concrete.

E. CBC - California Building Code, 2001 Edition

F. FS - Federal Specification
1. FF-B-588 - Bolt, Toggle and Expansion Sleeve, Screw.

G. NAAMM - National Association of Architectural Metal Manufacturers
1. MFM - Metal Finishes Manual for Architectural and Metal Products.

H. SSPC - The Society for Protective Coatings
1. PA-1 - Paint Application Specification No. 1.
2. SP-2 - Surface Preparation Specification No. 2: Hand Tool Cleaning.
3. SP-3 - Surface Preparation Specification No. 3: Power Tool Cleaning.
4. SP-6 - Surface Preparation Specification No. 6: Commercial Blast Cleaning.

1.03 SYSTEM DESCRIPTION

A. Design Requirements
1. Structural Performance of Handrails and Railing Systems: Engineer, fabricate and install handrails and railing systems to withstand structural loads without exceeding the allowable design working stress of the materials involved, including anchors and connections. Apply each load to produce the maximum stress in each of the respective components of each metal fabrication in accordance with CBC Table 23-A.
2. Design work to support normally imposed loads and in conformity with AISC requirements.
3. Provide for expansion and contraction.
4. Design exterior items to exclude water.
5. Shop drawings and calculations for metal fabrications engineered under work of this Section shall be prepared under direct supervision of State of California licensed Structural Engineer and shall be so stamped prior to submittal by the Contractor for review.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's product data for stair edgings, paint products and grout.

B. Shop Drawings: Submit shop drawings detailing fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide templates for anchors and bolts specified for installation under other Sections. Show location and type of backing for supports required at anchorage.

C. Samples: Submit samples representative of materials and finished products as may be requested by the Architect.

D. Quality Control Submittals
1. Certificates: Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

1.05 QUALITY ASSURANCE

A. Welding Standards: Comply with applicable provisions of AWS D1.1 and AWS D1.3.
1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.06 PROJECT CONDITIONS

A. Field Measurements
1. Check actual locations of walls and other construction to which metal fabrications must fit by accurate field measurements before fabrication. Show recorded measurements on final shop drawings.
2. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
a. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with fabricating products without field measurements. Coordinate construction to ensure that actual dimensions correspond to guaranteed dimensions. Allow for trimming and fitting.

1.07 COORDINATION

A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts and items with integral anchors that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General
1. Metal Surfaces: For metal fabrications exposed to view in the completed Work, provide materials selected for their surface flatness, smoothness, and freedom from surface blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names or roughness.
2. Provide steel with 25 percent minimum recycled steel content. In the case of comparable suppliers, preference shall be given to suppliers with highest recycled steel content in their product.

B. Steel and Iron
1. Steel Plates, Shapes and Bars: ASTM A36.
2. Stainless Steel Shapes: ASTM A276.
3. Cold-Formed Steel Tubing: ASTM A500.
a. For exterior installations and where indicated, provide tubing with hot-dip galvanized coating per ASTM A123.

4. Steel Pipe: ASTM A53, Type S, Grade B, Schedule 40, unless otherwise indicated, or another weight required by structural loads.
   a. Black finish, unless otherwise indicated.
   b. Galvanized finish for exterior installations and where indicated.
5. Concrete Inserts: Anchors of type indicated below, fabricated from corrosion resistant materials capable of sustaining, without failure, the load imposed within a safety factor of 4, as determined by testing per ASTM E488, conducted by a qualified independent testing agency.
   a. Threaded or wedge type; galvanized ferrous castings, either ASTM A47 malleable iron or ASTM A27 cast steel. Provide bolts, washers, and shims as required, hot-dip galvanized in accordance with ASTM A153.

C. Aluminum
   1. Extrusions: ASTM B221, alloy 6063-T6.

D. Fasteners: Provide plated fasteners complying with ASTM B633, Class Fe/Zn 25 for electrodeposited zinc coating, for exterior use or where built into exterior walls. Select fasteners for the type, grade, and class required.
   1. Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A, with hex nuts, ASTM A563, and, where indicated, flat washers.
   2. Machine Screws: ANSI B18.6.3.
   3. Plain Washers: Round, carbon steel, ANSI B18.22.1.
   4. Lock Washers: Helical, spring type, carbon steel, ANSI B18.21.1.
   5. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E488 conducted by a qualified independent testing agency. Testing shall be to twice the indicated tension capacity for the specific approved application listed in a current ICBO report for the expansion/sleeve anchor.
      a. Material: Carbon steel components zinc-plated to comply with ASTM B633, Class Fe/Zn 5.
      b. Material: Group 1 alloy 304 or 316 stainless steel bolts and nuts complying with ASTM F593 and ASTM F594.
   6. Toggle Bolts: FS FF-B-588, tumble-wing type, class and style as required.

E. Welding Materials: AWS D1.1, type required for materials being welded.

F. Handrail Brackets: Malleable iron, galvanized, and stainless steel complete with fasteners as appropriate to receiving surface, as manufactured by Julius Blum and Co., Inc., "No. 1378"; or equal.

G. Coatings
   1. Coatings for Protection of Dissimilar Materials
      a. Dissimilar Metals: Bituminous type materials conforming with MIL Standard 889.
      b. Aluminum in Contact with Concrete, Metal, Wood or other Absorptive Material.
   2. Shop Primer for Ferrous Metal: VOC compliant, fast-curing, lead and chromate free, universal modified alkyd primer with good resistance to corrosion, compatible with finish paint systems.
   3. Galvanizing Repair Paint: High zinc dust content paint, with dry film containing not less than 94 percent zinc dust by weight, as manufactured by Sherwin Williams, "Zinc Clad I", 101 Prospect Ave., Cleveland, OH 44115 (216) 566-2000; ZRC Chemical Products

Co., "ZRC Cold Galvanizing Compound",21 Newport Ave., Quincy, MA 02171 (617) 328-6700, or equal .

4. All items exposed to moisture or weather shall be hot dipped galvanized.

H. Nonshrink, Nonmetallic Grout

1. Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
2. Manufacturer: Five Star Products, Inc., "Five Star Grout", 425 Stillson Road, Fairfield, CT 06430 (203) 336-7900; Master Builders Technologies, Inc., "Masterflow 928 and 713", 23700 Chagrin Blvd., Cleveland, OH 44122 (216) 831-5500, or equal.

2.02 FABRICATION, GENERAL

A. Form metal fabrications from materials of size, thickness, and shapes indicated but not less than that needed to comply with performance requirements indicated. Work to dimensions indicated or accepted on shop drawings, using proven details of fabrication and support. Use type of materials indicated or specified for various components of each metal fabrication.

B. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.

C. Allow for thermal movement resulting from the following maximum change (range) in ambient temperature in the design, fabrication, and installation of installed metal assemblies to prevent buckling, opening up of joints, and overstressing of welds and fasteners. Base design calculations on actual surface temperatures of metals due to both solar heat gain and nighttime sky heat loss.

1. Temperature Change (Range): 100 degrees Fahrenheit.

D. Shear and punch metals cleanly and accurately. Remove burrs.

E. Ease exposed edges to a radius of approximately 1/32-inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

F. Remove sharp or rough areas on exposed traffic surfaces.

G. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing, and contour of welded surface matches those adjacent.

H. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

J. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

K. Cut, reinforce, drill, and tap metal fabrications as indicated on final Drawings to receive finish hardware, screws, and similar items.

L. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

2.03 STEEL GUARDRAILS, BOLLARDS, HANDRAILS AND RAILINGS

A. General: Fabricate guardrails, bollards, handrails and railing systems to comply with requirements indicated for design, dimensions, details, finish and member sizes, including thickness of handrails and posts, post spacings, and anchorage, but not less than that required to support structural loads.

B. Interconnect railing and handrail members by butt-welding or welding with internal connectors, at fabricator's option, unless otherwise indicated.

C. Form changes in direction of handrails and rails as detailed.

D. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated.

E. Brackets, Flanges, Fittings and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors for interconnections of metal work and attachment of handrails and railing systems to other work. Furnish inserts and other anchorage devices for connecting handrails and railing systems to concrete or masonry work.

F. Fillers: Provide steel sheet or plate fillers of thickness and size indicated or required to support structural loads of handrails where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses. Size fillers to produce adequate bearing to prevent bracket rotation and overstressing of substrate.

G. For galvanized handrails and railing systems, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

H. For non-galvanized steel handrails and railing systems, provide non-galvanized ferrous metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.

2.04 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports for applications indicated that are not a part of structural steel framework as required to complete the Work.

B. Fabricate units to sizes, shapes, and profiles indicated and required to receive other adjacent construction retained by framing and supports. Fabricate from structural steel shapes, plates, and steel bars of welded construction using mitered joints for field connection. Cut, drill, and tap units to receive hardware, hangers, and similar items.
   1. Equip units with integrally welded anchors for casting into concrete or building into masonry. Furnish inserts if units must be installed after concrete is placed.
      a. Except as otherwise indicated, space anchors 24 inches on center and provide minimum anchor units in the form of steel straps 1-1/4 inches wide by 1/4-inch thick by 8 inches long.

C. Galvanize miscellaneous interior and exterior framing and supports with climate exposure.

2.05 FINISHES, GENERAL

A. Comply with NAAMM MFM for recommendations relative to applying and designing finishes. Finish metal fabrications after assembly.

2.06 STEEL AND IRON FINISHES

A. Galvanizing: For those items indicated for galvanizing, apply zinc coating by the hot-dip process complying with the following requirements:
   1. ASTM A153 for galvanizing iron and steel hardware.
   2. ASTM A123 for galvanizing both fabricated and unfabricated iron and steel products made of uncoated rolled, pressed, and forged shapes, plates, bars, and strip 0.0299-inch thick or thicker.
   3. Loose Lintels: After galvanizing, dip lintels in vat of paint.

B. Preparation for Shop Priming: Prepare uncoated ferrous metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:
   1. Typical: SSPC SP-2, SSPC SP-3 as required.
   2. Architectural Exposed Steel Fabrications: SSPC SP-6.

C. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes or to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with requirements of SSPC PA-1 for shop painting.

D. Finish Painting: As specified in Section 09900.

E. Stainless Steel Finishes
   1. Remove or blend tool and die marks and stretch lines into finish.
   2. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
   3. Satin, Directional Polish: No. 6 finish.
   4. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

F. Aluminum: Manufacturer's standard powder coat finish with colors as selected by the Architect.

PART 3 - EXECUTION

3.01 PREPARATION

A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installing anchorages, including concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

B. Set sleeves in concrete with tops flush with finish surface elevations. Protect sleeves from water and concrete entry.

3.02 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction. Include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors as required.

B. Cutting, Fitting and Placement: Perform cutting, drilling, and fitting required for installing miscellaneous metal fabrications. Set metal fabrication accurately in location, alignment and elevation; with edges and surfaces level, plumb, true and free of rack; and measured from established lines and levels.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete masonry or similar construction.

D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop-welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are intended for bolted or screwed field connections.

E. Field Welding: Comply with the following requirements:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing, and contour of welded surface matches those adjacent.

F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

3.03 INSTALLING STEEL GUARDRAILS, RAILINGS AND HANDRAILS

A. Adjust handrails and railing systems prior to anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loadings. Plumb posts in each direction. Secure posts and railing ends to building construction as follows:
   1. Anchor posts to steel by welding directly to steel supporting members.

2. Anchor handrail ends into concrete and masonry with steel round flanges welded to rail ends and anchored into wall construction with drilled-in expansion anchors.

B. Secure handrails to wall with wall brackets and end fittings. Provide bracket with 1-1/2 inch clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads. Secure wall brackets and wall return fittings to building construction as follows:
   1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
   2. For hollow masonry anchorage, use toggle bolts having square heads.
   3. For steel framed gypsum board assemblies, fasten brackets directly to steel framing or concealed anchors using self-tapping screws of size and type required to support structural loads.

3.04 INSTALLING EDGINGS

A. Install with anchorage system indicated to comply with manufacturer's recommendations.

3.05 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC PA-1 requirements for touching up shop-painted surfaces.
   1. Apply by brush or spray to provide a 2.0-mil minimum dry film thickness.

B. For galvanized surfaces, clean welds, bolted connections and abraded areas, and apply galvanizing repair paint to comply with ASTM A780.

END OF SECTION